Reprinted from Wildlife Society Bulletin
Volume 26 Number 2 Summer 1998

Ineffectiveness of five commercial deterrents for nesting starlings

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Abstract We evaluated the effectiveness of phenethyl alcohol (PEA), eyespots, magnetic fields, and avian-predator effigies to deter European starlings (*Sturnus vulgaris*) from nesting in artificial cavities in Ohio during 1993, 1995, and 1996. Each year, 81 nest boxes attached to utility poles were assigned at random equally among 3 treatments (including control): 1993—PEA or eyespots, 1995—magnetic fields of 88 or 118 gauss, and 1996—great horned owl or merlin effigy. Starlings nested in 84% (1993), 58% (1995), and 90% (1996) of the boxes. There was no difference ($P \geq 0.13$) among treatments each year in 6–7 measures of starling nesting activity. Four species other than starlings (eastern bluebirds [*Sialia sialis*], house wrens [*Troglodytes aedon*], tree swallows [*Tachycineta bicolor*], and house sparrows [*Passer domesticus*]) occupied 13 (1993), 23 (1995), and 2 (1996) nest boxes. We conclude that PEA, eyespots, magnetic fields ≤118 gauss, and avian-predator effigies are ineffective as deterrents for starlings nesting in artificial cavities.

Key words avian-predator effigies, European starlings, eyespots, frightening devices, magnetic field, nesting, phenethyl alcohol, repellent, *Sturnus vulgaris*

European starlings (*Sturnus vulgaris*) and other birds nesting and roosting in urban areas result in numerous conflicts with people, including damage to buildings and other property, transmission of diseases, and safety issues at airports (Feare 1984, Godin 1994, Johnson and Glahn 1994). Because killing nuisance birds is often undesirable or infeasible, there is demand for effective, nonlethal means of deterring birds from problem sites. Although numerous devices are marketed as deterrents, few have been quantitatively evaluated. Quantitative evaluations often reveal the devices to be ineffective (Dolbeer et al. 1988, Bomford and O'Brien 1990).

Two devices that we decided to evaluate were odor-based repellents and eyespots. Although odor-based repellents tested to date have proven ineffective against birds (Dolbeer et al. 1988), Mikawa and Eiraku (1990) recently patented a phenethyl alcohol (PEA)-based product as a bird repellent in Japan. No data on the efficacy of this product have been published although preliminary evaluations of PEA as a repellent have been promising (J. R. Mason, U.S. Dep. Agric., pers. commun.; Mason and Silver 1983). Several reports suggest that eyespots may be effective for deterring starlings and other birds (Scaife 1976, Inglis et al. 1983, Shirota et al. 1983, Avery and Matteson 1995); however, no study has evaluated eyespots as a deterrent for nesting by birds.

Two additional devices, developed by Sho-Bond Corporation, Japan, are marketed in the United States for use in and around buildings, at airports, and in agricultural fields. The products are Bird-Mag™ (1.5-cm diam spherical magnets attached to a wire at 25-cm intervals) and Bird-Peller™ (4 1.5-cm diam hemispherical magnets attached to a propeller at 6-cm intervals). The manufacturer states that these 2 products generate magnetic fields that disorient and, consequently, deter birds, from areas influenced by the magnets (McDonald 1994). Several airports in the United States either are using or are considering

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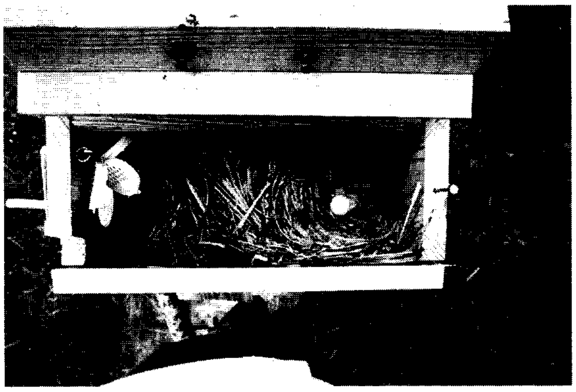

Nest box (with lid removed) showing capsules containing phenethyl alcohol (a candidate bird-repellent) and European starling nest with nestlings, Erie County, Ohio.

use of these devices for nuisance bird management (R. A. Dolbeer, unpubl. data). No study has evaluated whether introduced magnetic fields repel birds or if habituation occurs.

Avian predator effigies are frequently marketed as effective devices in deterring nuisance birds. Although these effigies have potential as frightening devices (Conover 1979, Johnson and Glahn 1994), their effectiveness in deterring nesting has not been evaluated. We evaluated the efficacy of PEA, eyespots, magnetic fields, and avian-predator effigies as deterrents for starlings nesting in artificial cavities.

Methods

We conducted 3 experiments, 1 each in 1993, 1995, and 1996. Eighty-one nest boxes (28 x 13 x 17 cm) with removable roofs (Dolbeer et al. 1988) were attached (Mar 1993) to utility poles at the 2,200-ha National Aeronautic and Space Administration (NASA) Plum Brook Station, Erie County, Ohio. Nest boxes were ≥240 m apart and their entrances were covered until the first day of treatment in each year (28 Apr 1993, 26 May 1995, 9 Apr 1996). For each experiment, we assigned boxes at random among 3 treatments (1993—untreated, PEA, or eyespots; 1995—0, 2, or 6 magnets; 1996—untreated, great-horned owl, or merlin); each treatment comprised 27 replicates.

In 1993, we placed 3 Histo Prep Capsules (38-mm diam x 8 mm high; Fisher Scientific, Chicago, Ill.) in each PEA-treated box. Each capsule contained 5 discs (30-mm diam) of absorbent material (machinery wiping towel) saturated with 1.5 ml of PEA. Capsules were attached inside the box above the entrance and secured with a screw eye and safety-pin. We replenished each capsule with 1.0 ml of PEA every 7-12 days. Based on findings of Inglis et al. (1983), we placed 2 2-cm diameter, straw-colored taxidermy eyes with 1-cm black pupils (Van Dyke's, Woonsocket, S.D.) 6 cm apart (center to center) and immediately above the entrance hole on the outside of each eyespot-treatment box. The eyes were secured with a wire and staples. Nothing was placed in or on the control boxes.

In 1995, we placed 2 galvanized-steel truss plates (12.6 x 8 x 0.1 cm), each with 1 or 3 ceramic magnets or 1 ceramic nonmagnet (4.5 x 2.2 x 1 cm; Duramax® DM-880; Duramagnets, Inc., Toledo, Oh.) attached, in each nest box. Each Duramax magnet (magnetic field about 1,400 gauss) would attract a standard-size steel paper clip suspended by a thread at approximately 7.5 cm (a single magnet [maximum field about 900 gauss] from the Bird-Mag would attract the same paper clip at 4 cm). One gauss is equal to 1 line of magnetic flux per cm^2 per second. Magnets were centered vertically (with the same magnetic polarity, North or South) and perpendicular to the long axis of the steel plate and attached with hot glue (3 magnets were 1.5 cm apart; single magnets or nonmagnets were centered on the plate). Plates were attached horizontally with thumbtacks to opposing walls on the inside of the box, abutting the back wall and floor. The pair or pairs of magnets in each nest box faced each other with opposing (North-South) polarity. Thus, the center of the magnetic fields were 6.3 cm from the back of the box. Maximum magnetic fields, measured 3 cm above the bottom of the box and equidistant between the 2 plates, were 88 and 118 gauss for 2- and 6-magnet treatments, respectively. Magnetic fields for 2- and 6-magnet treatments measured 11.0 cm from the center of the magnetic field (10 cm from the inside front wall) were 0 and ≤5 gauss, respectively. Two ceramic nonmagnets were similarly mounted to truss plates and attached in each of the control boxes.

In 1996, we obtained great-horned owl (41 cm high; Dalen Products, Knoxville, Tenn.) and merlin ("pigeon hawk"; 36 cm long, 53-cm wingspan; Bird-X, Chicago, Ill.) effigies made of mold-injected plastic and hand-painted. Owls were secured to utility poles with wire about 10 cm above nest-box entrances. Merlin effigies had been equipped by the manufacturer with spring-steel support wires attached with 2 pieces of monofilament line. We attached the wires to utility poles so that merlins were suspended directly over nest-box entrances. Wind caused the merlins to move, which the manufacturer suggested would enhance efficacy. However, within 2 days of attachment, the monofilament lines of several merlins broke, and several additional merlins were entan-

Nest box showing great horned owl effigy and nesting European starling leaving box to find food for nestlings, Erie County, Ohio. Photo by T. W. Seamans.

gled in the lines. Reattaching merlins to support wires using line with greater tensile strength (10 kg) also proved unsuccessful. We corrected this problem 1 week after initial attachment by using wire to rigidly secure merlins directly to the support wires.

In 1993, we inspected nest boxes 2–3 times per week in May, 2 times per week in June–July, and 1 time per week in August. In 1995 and 1996, we inspected nest boxes 1 time per week from late May to early August and mid-April to early July, respectively. During each inspection, we recorded the following data: presence of nest, species using box, and number of eggs and nestlings. We interpolated the date that the first egg was laid in each nest box, using the number of eggs present (assuming a 24-hr egg-laying interval; Feare 1984) and date of the last nest-box inspection. In 1995, we also recorded the distance (cm) from the center of the nest to the inside back wall of the nest box.

For each experiment, we used chi-square statistics (SAS Inst. Inc. 1988) to compare the proportion of nest boxes with nests, eggs, and nestlings among treatments. We used 1-way analysis of variance (ANOVA) to compare estimated mean date on which the first egg was laid, clutch size, and number of nestlings among treatments in each experiment. We also used ANOVA in 1995 to compare positions of nests in relation to magnetic fields among treatments.

Results

Starlings nested in 84% (1993), 58% (1995), and 90% (1996) of the 81 boxes. During each year, there was no difference ($P \geq 0.13$) among treatments in the proportion of nest boxes with nests, eggs, or nestlings (Table 1). Mean dates of first egg, clutch size, and number of nestlings were also similar ($P \geq 0.13$) among treatments each year. In 1995, the overall mean distance starlings nested from the back of the nest box was 4.3 cm (2.0 cm from the center of the magnetic fields), which was similar ($P = 0.70$) among treatments.

Four species other than starlings occupied nest boxes during the study: eastern bluebirds (*Sialia sialis*), 17 nests; house wrens (*Troglodytes aedon*), 15 nests; tree swallows (*Tachycineta bicolor*), 5 nests; and house sparrows (*Passer domesticus*), 1 nest.

Discussion

Starlings have olfactory and trigeminal capabilities that allow them to detect volatile compounds, including alcohols (Mason and Silver 1983, Clark and Mason 1987, Clark 1996). Although the level of PEA tested in our experiment had no apparent repellent effect on starlings, the PEA odor was readily apparent to humans when nest boxes were checked. In a similar study, Dolbeer et al. (1988) determined that naphthalene was ineffective as a starling nesting repellent.

Eyespots also were ineffective in reducing starling nesting activity. Color, shape, size, and orientation of eyespots can influence their effectiveness (Scaife 1976, Inglis et al. 1983). The eyespots we used had those characteristics that Scaife (1976) and Inglis et al. (1983) determined to be most effective. Avery and Matteson (1995) determined that 16.5-cm diameter eyespots with red irises reduced feeding by starlings initially, but that continuous exposure of starlings to these eyespots resulted in rapid habituation (≤24 hrs). Increasing the number of cues a bird receives from the frightening device (e.g., eyespots with feathers or beak) may enhance effigy realism and effectiveness (Inglis et al. 1983).

Conover (1979, 1982) and Hothem and DeHaven (1982) determined that museum mounts of raptors and kites resembling raptors, suspended from helium-filled balloons, reduced bird damage to blueberries and grapes. Conover (1982) suggested that increased movements of kites increased their effectiveness; however, habituation began to occur within 1 week. Changing kite components or locations of deployment may also increase effectiveness (Shalter 1978, Hothem and DeHaven 1982). Nonetheless, avian-predator effigies appear ineffective in reducing starling use of nest boxes. Any enhancement in effectiveness caused by movements of effigies would likely be limited.

Table 1. Nesting activity by European starlings in nest boxes untreated or treated with phenethyl alcohol (PEA), eyespots, magnetic fields (2 magnets = 88 gauss, 6 magnets = 118 gauss), or avian-predator effigies (merlin and great-horned owl), Erie County, Ohio, April–August, 1993, 1995, 1996.

	1993			1995			1996		
Nesting parameter	Untreated	PEA	Eyespots	0 magnets	2 magnets	6 magnets	Untreated	Merlin	Owl
Nest boxes available[a]	22	21	25	20	22	16	27	27	25
With nests[b]	21	19	22	18	17	12	26	26	21
With eggs[b]	21	19	22	14	17	9	26	24	21
With nestlings[b]	17	17	20	10	15	8	25	23	20
Date of first egg[c]	10 May	14 May	9 May	3 Jun	7 Jun	2 Jun	2 May	6 May	4 May
Clutch size ($\bar{x}$ [SD])[c]	4.2 (1.2)	4.3 (1.3)	4.4 (0.7)	4.3 (0.6)	4.0 (1.1)	4.0 (1.3)	4.8 (0.9)	4.5 (0.9)	4.3 (1.1)
No. of nestlings ($\bar{x}$ [SD])[c]	2.9 (1.8)	3.3 (1.7)	3.7 (1.6)	2.8 (1.7)	2.9 (1.8)	3.6 (1.6)	3.7 (1.3)	3.4 (1.2)	3.6 (1.2)
Distance (cm): nest center to back of box ($\bar{x}$ [SD])[d]				4.3 (0.7)	4.2 (0.6)	4.4 (0.5)			
Other species nesting[e]	5	6	2	7	5	11	0	0	2

[a] Excludes nest boxes occupied by other species; each treatment included 27 replicates.
[b] Means are not different among treatments for each year (χ^2 = 0.26–4.15, 2 df, $P \geq 0.13$).
[c] Means are not different among treatments (1993: F = 0.22–2.10, 2,59 df, $P \geq 0.13$; 1995: F = 0.38–1.08, 2,36 df, $P \geq 0.35$; 1996: F = 0.37–1.48; 2,67 df; $P \geq 0.24$).
[d] Means are not different among treatments (F = 0.36; 2,36 df; P = 0.70).
[e] Eastern bluebirds (17), house wrens (15), tree swallows (5), and house sparrows (1).

Magnetic fields of 88 and 118 gauss did not reduce occurrence of nesting or reproductive success of starlings. Many species of birds use the Earth's magnetic field to aid in orientation and migration (Moore 1975; Southern 1974, 1978; Wiltschko et al. 1981). As the earth's magnetic field ranges from 0.3 to 0.6 gauss (Able 1994), we assume that starlings detected the magnetic fields present in nest boxes (about 150–200 times greater than the earth's magnetic field) but were not repelled by them. In addition, starlings nested near the centers of the magnetic fields although they could have nested near entrances (with substantially lower magnetic fields; ≤5 gauss) of the same nest boxes. Birds may become disoriented when exposed to magnetic anomalies or introduced magnetic fields (Alerstam 1990, Able 1994). Southern (1974, 1978) and Moore (1975), however, evaluated the effects of magnetic fields on gull orientation and found no evidence that introduced magnetic fields caused avoidance.

Starlings could not have exhibited more than a neophobic response to any of the devices tested. Habituation to these devices may be attributed in part to a lack of negative reinforcement. Control techniques that do not include exclusion or some other form of physical deterrence frequently have only short-term effectiveness. Also, integration of multiple control techniques (e.g., eyespots with broadcast distress calls) is likely more effective than use of individual techniques (Inglis et al. 1983, Mason 1989, U.S. Dep. Agric. 1993).

We conclude that PEA, eyespots, magnetic fields ≤118 gauss, and avian-predator effigies are ineffective as deterrents for starlings nesting in artificial structures. However, these devices may have application in other situations. As suggested with avian feeding repellents, the effectiveness of the deterrent appears associated with the relative attractiveness of the material (or area) being protected (Belant et al. 1996). Thus, starlings may be easier to deter from roosting or feeding areas than from nest sites, particularly when nest sites are limited.

Acknowledgments. We thank C. R. Bartholomew, K. A. Bennett, G. E. Bernhardt, H. E. Bolte, S. W. Gabrey, S. K. Ickes, K. D. Madaras, E. J. Marshall, M. R. Rutger, and L. A. Tyson for field assistance; M. R. Rutger constructed most of the nest boxes. A. L. Bower (NASA) provided access to study sites. R. Csortos (Duramagnets, Inc., Toledo, Oh.) and R. A. Ziemke (NASA) provided assistance acquiring magnets, measuring magnetic fields, and mounting magnets to produce maximum magnetic fields. Sponsorship and funding for this research was provided by the Federal Aviation Administration (FAA); Office of Airport Safety and Standards, Washington, D.C.; and Airports Division, Airport Technology Branch, FAA Technical Center, Atlantic City International Airport, New Jersey.

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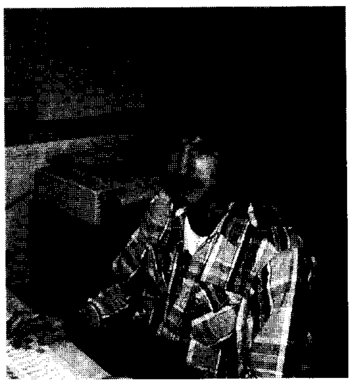

Jerrold L. Belant (photo), a native of Wisconsin, has B.S. and M.S. degrees from the University of Wisconsin, Stevens Point. He has broad wildlife work experience, including research on predator control for waterfowl production and rabies suppression, loon reproduction, black bear and moose population dynamics, gull movements in relation to landfills, and development of wildlife repellents. A former researcher at the USDA's National Wildlife Research Center (NWRC) field station in Sandusky, Ohio, Jerry now is a biologist for the National Park Service at Denali National Park and Preserve, Alaska. ***Paul P. Woronecki*** (B.S., University of Connecticut; M.S., Virginia Polytechnic Institute) recently retired after a 32-year career in wildlife damage control with the NWRC. ***Richard A. Dolbeer*** (project leader) and ***Thomas W. Seamans*** (biologist) are NWRC employees at Sandusky involved in various research projects to resolve conflicts between humans and wildlife, especially at airports. Richard has degrees from the University of the South (B.A.), University of Tennessee (M.S.), and Colorado State University (Ph.D.). Tom has a B.S. degree from Cornell University and an M.S. degree from Ohio State University.

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